PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-314541
(43)Date of publication of application : 06.11.2003

(51)Int.Cl. F16C 19/18
F16H 57/02

(21)Application number : 2002-117091
(22)Date of filing : 19.04.2002

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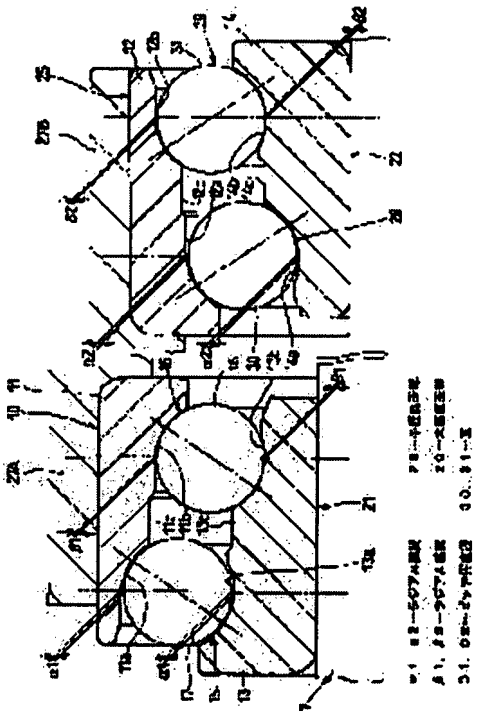
(54) DOUBLE ROW ROLLING BEARING

(57)Abstract:
PROBLEM TO BE SOLVED: To solve problems in which lives of balls on both rows are different if a radial gap between the balls on both rows and the raceways is set equal and the life of the whole double row ball bearing becomes shorter, in case that the double row ball bearing is used for a pinion shaft supporting unit of a differential gear.
SOLUTION: Upon applying the double row ball bearings 10 and 25 to the differential gear 1, radial gaps $\alpha 1$ and $\alpha 2$ of a group of balls 15 at a large diameter side and a group of balls 28 at a small diameter side are made larger than radial gaps $\beta 1$ and $\beta 2$ of a group of balls 16 at a small diameter side and a group of balls 29 at a large diameter side, when loads are applied to respective double row ball bearings 10 and 25. Accordingly, the loads are first carried by the group of balls 16 at the small diameter side and the group of balls 29 at the large diameter side, and are then carried by the group of balls 15 at the large diameter side and the group of balls 28 at the small diameter side in sequence. Thus, a system life of respective double row ball bearings 10 and 25, especially the lives for the group of balls 15 at the large diameter side and the group of balls 28 at the small diameter side, are further extended.



LEGAL STATUS

[Date of request for examination] 02.11.2004

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] With the inner-ring-of-spiral-wound-gasket member which has the orbital plane of a double row, among these, the outer-ring-of-spiral-wound-gasket member which has the orbital plane of a double row which is arranged at wheel part material and this alignment, and corresponds with each orbital plane of said inner-ring-of-spiral-wound-gasket member, It is double row anti-friction bearing containing the rolling element of the double row infixed, respectively between the orbital planes of each train of said inner-ring-of-spiral-wound-gasket member and an outer-ring-of-spiral-wound-gasket member. Double row anti-friction bearing characterized by what the radial internal clearance between the rolling element arranged among the rolling elements of said double row at a small load side and its orbital plane is small set up for compared with the radial internal clearance between the rolling element arranged among the rolling elements of said double row at a large load side, and its orbital plane.
[Claim 2] With the inner-ring-of-spiral-wound-gasket member which has the orbital plane of a double row, among these, the outer-ring-of-spiral-wound-gasket member which has the orbital plane of a double row which is arranged at wheel part material and this alignment, and corresponds with each orbital plane of said inner-ring-of-spiral-wound-gasket member, It is double row anti-friction bearing containing the rolling element of the double row infixed with a pitch diameter different, respectively between the orbital planes of each train of said inner-ring-of-spiral-wound-gasket member and an outer-ring-of-spiral-wound-gasket member. Double row anti-friction bearing characterized by what the radial internal clearance between the rolling element arranged among the rolling elements of said double row at a small load side and its orbital plane is small set up for compared with the radial internal clearance between the rolling element arranged among the rolling elements of said double row at a large load side, and its orbital plane.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to double row anti-friction bearing used for the differential equipment carried in a car.
[0002]
[Description of the Prior Art] Drawing 7 shows the cross-section structure of conventional differential equipment 100. This differential equipment 100 has the pinion shaft (drive pinion) 102 in that differential casing 101, and this pinion shaft 102 has the pinion gear 106 which gears to the ring wheel 108 of the differential change gear style 107 at that 1 side. This pinion shaft 102 is supported by the tapered roller bearing 103,104 of the pair single row estranged and arranged in the direction of an axial center free [rotation] again at the circumference of an axial center. The flange yoke 105 connected with a non-illustrated driveshaft is formed in the edge of the pinion shaft 102.
[0003] With the above-mentioned differential equipment 100, the bearing supported for the pinion shaft 102, enabling free rotation consists of a tapered roller bearing 103,104. Especially, big frictional resistance works to the tapered roller bearing 103 by the side of the big pinion gear 106 of thrust loading. For this reason, running torque becomes large and it is possible that the effectiveness of differential equipment 100 falls.
[0004]
[Problem(s) to be Solved by the Invention] Then, it is possible to replace the bearing by the side of a pinion gear 106 with a tapered roller bearing 103, and to use the double row ball bearing of a tandem die. Thus, when replacing with a tapered roller bearing 103 and using the double row ball bearing of a tandem die, the direction of the load to the ball by the side of a pinion gear 106 becomes larger than the load to the ball by the side of the anti-pinion gear 106.
[0005] For this reason, if the radial internal clearance of the ball of each train and an orbital plane is equally set up when a double row ball bearing is used for the above-mentioned differential equipment 100, the lives of the ball of both trains differ greatly and it is possible that a life becomes short as the whole double row ball bearing.
[0006]
[Means for Solving the Problem] Double row anti-friction bearing of this invention with the inner-ring-of-spiral-wound-gasket member which has the orbital plane of a double row Among these, the outer-ring-of-spiral-wound-gasket member which has the orbital plane of a double row which is arranged at wheel part material and this alignment, and corresponds with each orbital plane of said inner-ring-of-spiral-wound-gasket member, The rolling element of the double row infixed, respectively between the orbital planes of each train of said inner-ring-of-spiral-wound-gasket member and an outer-ring-of-spiral-wound-gasket member is included. The radial internal clearance between the rolling element arranged among the rolling elements of these double rows at a small load side and its orbital plane is small set up compared with the radial internal clearance between the rolling element arranged among the rolling elements of said double row at a large load side, and its orbital plane.
[0007] By having set up small the radial internal clearance between the rolling element arranged at a small load side, and its orbital plane like the above-mentioned configuration compared with the radial internal clearance between the rolling element arranged among the rolling elements of a double row at a large load side, and its orbital plane In case a load is paid by the rolling element, a load is mainly supported by the rolling element by which a load is arranged first at a small side. When a still bigger load works, the radial internal clearance in the rolling element by which a load is arranged at a large side is packed, and the assignment of load bearing is made so that a load may be supported by the rolling element here. Thereby, the life of each rolling element is equalized and the system life of the whole double row anti-friction bearing is prolonged.
[0008] Moreover, the inner-ring-of-spiral-wound-gasket member in which double row anti-friction bearing of this

invention has the orbital plane of a double row, The outer-ring-of-spiral-wound-gasket member which has the orbital plane of a double row which is arranged at this inner-ring-of-spiral-wound-gasket member and this alignment, and corresponds with each orbital plane of said inner-ring-of-spiral-wound-gasket member, The rolling element of the double row infixed with a pitch diameter different, respectively between the orbital planes of each train of said inner-ring-of-spiral-wound-gasket member and an outer-ring-of-spiral-wound-gasket member is included. The radial internal clearance between the rolling element arranged among the rolling elements of these double rows at a small load side and its orbital plane is small set up compared with the radial internal clearance between the rolling element arranged among the rolling elements of said double row at a large load side, and its orbital plane.

[0009] Also in this case, like the above the radial internal clearance between the rolling element arranged at a small load side, and its orbital plane By having set up small compared with the radial internal clearance between the rolling element arranged among the rolling elements of said double row at a large load side, and its orbital plane In case a load is paid by the rolling element, a load is mainly supported by the rolling element by which a load is arranged first at a small side. When a still bigger load works, the radial internal clearance in the rolling element by which a load is arranged at a large side is packed, and the assignment of load bearing is made so that a load may be supported by the rolling element here. Thereby, the life of each rolling element is equalized and the system life of the whole double row anti-friction bearing is prolonged.

[0010] In addition, the above-mentioned rolling element means a ball or time, as for all of the rolling element of both trains, is good also as a configuration using a ball, and may constitute all of the rolling element of both trains using time. Or a load load uses time as a rolling element of a large side, and you may make it use a ball as a rolling element of a side with a small load load.

[0011]

[Embodiment of the Invention] The case where the double row ball bearing of this invention is made to apply to the bearing for pinion shaft support of the differential equipment attached to a car hereafter is explained to an example based on a drawing.

[0012] A linearity Fig. when the sectional view in which the sectional view in which drawing 1 shows the outline configuration of differential equipment, and drawing 2 show an important section expanded sectional view, and drawing 3 shows the condition in the middle of attachment of a double row ball bearing, the expanded sectional view to which drawing 4 expresses the radial internal clearance in a double row ball bearing, and drawing 5 equip a pinion shaft with each double row ball bearing, and drawing 6 are the graphical representations at the time of making an axis of abscissa into a radial internal clearance, and making an axis of ordinate into a system life.

[0013] As shown in drawing 1 , said differential equipment 1 has differential casing 2. This differential casing 2 consists of a front case 3 and a rear case 4, and both 3 and 4 are attached by bolt nut 2a. Among the front cases 3, the annular walls 27A and 27B for bearing wearing are formed in the way. This differential casing 2 is carrying out the interior of the pinion shaft (drive pinion) 7 which has a pinion gear 6 to the differential change gear style [which carries out differential linkage of the wheel on either side] 5, and 1 side. The pinion gear 6 has geared to the ring wheel 8 of the differential change gear style 5. The shank 9 of the pinion shaft 7 is formed in the shape of a stage by the side else so that it may become a minor diameter compared with 1 side.

[0014] The shank 9 of the pinion shaft 7 is supported free [the rotation to the circumference of an axial center] by annular wall 27A formed in the front case 3 through the first double row ball bearing 10 in the 1 side. In addition to this, the shank 9 of the pinion shaft 7 is supported by annular wall 27B of the front case 3 free [rotation] through the second double row ball bearing 25 at the circumference of an axial center in the side.

[0015] As shown in drawing 2 , the first double row ball bearing 10 consists of the first single outer-ring-of-spiral-wound-gasket member 11 which has major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a by the side of a pinion, and minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b by the side of an anti-pinion, and the first assembly 21. The first double row ball bearing 10 consists of turning the first assembly 21 to the first outer-ring-of-spiral-wound-gasket member 11 from a pinion side at an anti-pinion side, and attaching from an axial center.

[0016] The first outer-ring-of-spiral-wound-gasket member 11 is attached in the inner skin of the annular wall 27. The counter-bored outer ring is used as this first outer-ring-of-spiral-wound-gasket member 11. Between major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a of this first outer-ring-of-spiral-wound-gasket member 11, and minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b, flat-surface section 11c which follows major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a by the major diameter from minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b is formed. Of this configuration, the inner skin of the first outer-ring-of-spiral-wound-gasket member 11 is formed in the shape of a stage.

[0017] The first single inner-ring-of-spiral-wound-gasket member 13 which has major-diameter inner-ring-of-

spiral-wound-gasket orbital plane 13a to which the first assembly 21 counters major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a of the first outer-ring-of-spiral-wound-gasket member 11 in the direction of a path, and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 13b which counters minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b in the direction of a path, It consists of a major-diameter side ball group 15 by the side of a pinion and a minor diameter side ball group 16 by the side of an anti-pinion, and cages 19 and 20 that hold the balls 17 and 18 which constitute each ball groups 15 and 16 to ******, such as a circumferencial direction.

[0018] The shoulder dropping inner ring of spiral wound gasket is used as first inner-ring-of-spiral-wound-gasket member 13. The first inner-ring-of-spiral-wound-gasket member 13 is inserted in the pinion shaft 7. The end face in the first inner-ring-of-spiral-wound-gasket member 13 contacts the end face of a pinion gear 6 from an axial center, and the first inner-ring-of-spiral-wound-gasket member 13 is pinched from the axial center with the end face of a pinion gear 6, and the plastic spacer 23 for a precompression setup by which outer fitting was carried out in the middle of the shank 9 of the pinion shaft 7.

[0019] Between major-diameter inner-ring-of-spiral-wound-gasket orbital plane 13a and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 13b, flat-surface section 13c which follows major-diameter inner-ring-of-spiral-wound-gasket orbital plane 13a by the major diameter from minor diameter inner-ring-of-spiral-wound-gasket orbital plane 13b is formed. Of this configuration, the peripheral face of the first inner-ring-of-spiral-wound-gasket member 13 is formed in the shape of a stage.

[0020] The major-diameter side ball group 15 is arranged through the predetermined radial internal clearance alpha 1 between major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 13a. The minor diameter side ball group 16 is arranged through the predetermined radial internal clearance beta 1 smaller than a radial internal clearance alpha 1 between minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 13b.

[0021] In this first double row ball bearing 10, the path of the ball 17 in the major-diameter side ball group 15 and the path of the ball 18 in the minor diameter side ball group 16 are formed equally, and the pitch diameters D1 and D2 of each ball groups 15 and 16 differ, respectively. That is, the pitch diameter D1 of the major-diameter side ball group 15 is set up more greatly than the pitch diameter D2 of the minor diameter side ball group 16. Thus, the first double row ball bearing 10 which has the ball groups 15 and 16 from which pitch diameters D1 and D2 differ is called the double row ball bearing of a tandem die.

[0022] The second double row ball bearing 25 consists of the second single outer-ring-of-spiral-wound-gasket member 12 which has minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12a by the side of a pinion, and major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12b by the side of an anti-pinion, and the second assembly 22. The second double row ball bearing 25 consists of turning the second assembly 22 to the second outer-ring-of-spiral-wound-gasket member 12 from an anti-pinion side to a pinion side, and attaching from an axial center. Flat-surface section 12c which follows major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12a by the major diameter from minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12b between major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12a and minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12b is formed in this second outer-ring-of-spiral-wound-gasket member 12. Of this configuration, the inner skin of the second outer-ring-of-spiral-wound-gasket member 12 is formed in the shape of a stage. The second outer-ring-of-spiral-wound-gasket member 12 is attached in the inner skin of annular wall 27B. The counter-bored outer ring is used as this second outer-ring-of-spiral-wound-gasket member 12.

[0023] The second single inner-ring-of-spiral-wound-gasket member 14 which has minor diameter inner-ring-of-spiral-wound-gasket orbital plane 14a to which the second assembly 22 counters minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12a of the second outer-ring-of-spiral-wound-gasket member 12 in the direction of a path, and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 14b which counters major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12b in the direction of a path, It consists of a minor diameter side ball group 28 by the side of a pinion and a major-diameter side ball group 29 by the side of an anti-pinion, and cages 32 and 33 that hold the balls 30 and 31 which constitute each ball groups 28 and 29 to ******, such as a circumferencial direction. The shoulder dropping inner ring of spiral wound gasket is used as second inner-ring-of-spiral-wound-gasket member 14. The second inner-ring-of-spiral-wound-gasket member 14 is inserted in the pinion shaft 7, and the second inner-ring-of-spiral-wound-gasket member 14 is pinched from the axial center with the plastic spacer 23 and shield 37 for a precompression setup.

[0024] Between minor diameter inner-ring-of-spiral-wound-gasket orbital plane 14a and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 14b, flat-surface section 14c which follows minor diameter inner-ring-of-

spiral-wound-gasket orbital plane 14a in a minor diameter from major-diameter inner-ring-of-spiral-wound-gasket orbital plane 14b is formed. Of this configuration, the peripheral face of the first inner-ring-of-spiral-wound-gasket member 14 is formed in the shape of a stage.

[0025] The minor diameter side ball group 28 is arranged through the predetermined radial internal clearance alpha 2 between minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12a and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 14a. The major-diameter side ball group 29 is arranged through the predetermined radial internal clearance beta 2 smaller than the predetermined radial internal clearance alpha 2 between major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12b and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 14b.

[0026] In this second double row ball bearing 25, the path of the ball 30 in the minor diameter side ball group 28 and the path of the ball 31 in the major-diameter side ball group 29 are formed equally, and the pitch diameters D3 and D4 of each ball groups 28 and 29 differ, respectively. That is, the pitch diameter D3 of the major-diameter side ball group 28 is set up smaller than the pitch diameter D4 of the minor diameter side ball group 29. This second double row ball bearing 25 is also a double row ball bearing of a tandem die.

[0027] The oil circuit 40 is formed between annular wall 27A by the side of the outer wall of the front case 3, and 1, opening of the oil inlet port 41 of this oil circuit 40 is carried out to the ring wheel 8 side of the oil circuit 40, and opening of the oil outlet 42 of the oil circuit 40 is carried out between annular wall 27A and 27B.

[0028] Differential equipment 1 has a flange yoke 43. This flange yoke 43 has a drum section 44 and the flange 45 formed in this drum section 44 in one. A drum section 44 is attached outside the side other than the shank 9 of the pinion shaft 7 (i.e., a non-illustrated drive shaft). Said shield 37 is infixed between the 1 side-edge side of a drum section 44, and the second inner-ring-of-spiral-wound-gasket member 14 end face of the second double row ball bearing 25. Oil seal 46 is arranged between the peripheral face of a drum section 44, and side opening inner skin besides the front case 3. Oil seal 46 is attached in the seal protection cup 47 of a wrap sake by side opening besides the front case 3. The thread part 48 was formed in the side heel besides a shank 9, and this thread part 48 is projected to the central crevice 41 of a flange 45. The nut 49 is screwed on the thread part 48.

[0029] Thus, the first inner-ring-of-spiral-wound-gasket member 13 of the first double row ball bearing 10 and the second inner-ring-of-spiral-wound-gasket member 14 of the second double row ball bearing 25 are put in the direction of an axial center by a nut 49 being screwed on a thread part 48 by the end face of a pinion gear 6, and the end face of a flange yoke 43. It will be in the condition that predetermined precompression was given to the balls 17 and 18 of the first double row ball bearing 10, and the balls 30 and 31 of the second double row ball bearing 25, through a shield 37 and the plastic spacer 23.

[0030] In the differential equipment 1 of the above-mentioned configuration, the oil 50 for lubrication is stored on level L in the shutdown condition in differential casing 2. Oil 50 is drawn so that it may have bounded with rotation of a ring wheel 8 at the time of operation and the upper part of the first double row ball bearing 10 and the second double row ball bearing 25 may be supplied through the oil circuit 40 within the front case 3, and it circulates through the inside of differential casing 2 so that the lubrication of the first double row ball bearing 10 and the second double row ball bearing 25 may be carried out.

[0031] Next, the assembly approach of such differential equipment 1 is explained. On the occasion of ******, the first double row ball bearing 10 is beforehand assembled for differential equipment 1, and the radial internal clearance alpha 1 between the major-diameter side ball group 15, and major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 13a is adjusted. Moreover, the radial internal clearance beta 1 between the minor diameter side ball group 15, and minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 13b is adjusted. That is, radial internal clearances alpha1 and beta1 are managed so that a radial internal clearance beta 1 may become small compared with a radial internal clearance alpha 1.

[0032] Moreover, on the occasion of ******, the second double row ball bearing 25 is beforehand assembled for differential equipment 1, and the radial internal clearance alpha 2 between the minor diameter side ball group 28, and minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12a and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 14a is adjusted. Moreover, the radial internal clearance beta 2 between the major-diameter side ball group 29, and major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12b and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 14b is adjusted. That is, radial internal clearances alpha2 and beta2 are managed so that a radial internal clearance beta 2 may become small compared with a radial internal clearance alpha 2.

[0033] And the first outer-ring-of-spiral-wound-gasket member 11 in the first double row ball bearing 10 and the second outer-ring-of-spiral-wound-gasket member 12 in the second double row ball bearing 25 are pressed fit in the annular walls 27A and 27B, respectively.

[0034] Apart from this, the first inner-ring-of-spiral-wound-gasket member 13 is inserted in the pinion shaft 7 for the first assembly 21 of the first double row ball bearing 10, and the first assembly 21 is located in the pinion gear 6 side of the shank 9 of the pinion shaft 7. Next, the first outer-ring-of-spiral-wound-gasket member 11 in the first double row ball bearing 10 is included in the front case 3 in the condition of having made the front case 3 and the rear case 4 still separating. At this time, the first outer-ring-of-spiral-wound-gasket member 11 is pressed fit to the direction of axial center predetermined location equivalent to the step currently formed in the annular wall 27 from 1 side opening of the front case 3. Moreover, the second outer-ring-of-spiral-wound-gasket member 12 of the second double row ball bearing 25 is pressed fit to the direction of axial center predetermined location which hits the step currently formed in the annular wall 28 from side opening besides the front case 3.
[0035] Apart from this, the first inner-ring-of-spiral-wound-gasket member 13 is inserted in the shank 9 of the pinion shaft 7, and the first assembly 21 is attached.
[0036] The pinion shaft 7 which attached the first assembly 21 as mentioned above from the minor diameter side Moreover, from 1 side opening of the front case 3, it inserts so that the ball 18 of the minor diameter side ball group 16 of the first assembly 21 may fit into minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b of the first outer-ring-of-spiral-wound-gasket member 11, and so that the ball 17 of the major-diameter side ball group 15 of the first assembly 21 may fit into major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a of the first outer-ring-of-spiral-wound-gasket member 11.
[0037] Next, outer fitting insertion of the plastic spacer 23 is carried out from side opening besides the front case 3 at the shank 9 of the pinion shaft 7. Then, insertion wearing of the second inner-ring-of-spiral-wound-gasket member 14 is carried out for the second assembly 22 in the second double row ball bearing 25 from side opening besides the front case 3 at the shank 9 of the pinion shaft 7.
[0038] Then, a shield 37 is inserted in the shank 9 of the pinion shaft 7 from side opening besides the front case 3, it equips with oil seal 46, the seal protection cup 47 is attached in side opening besides the front case 3, the drum section 44 of a flange yoke 43 is inserted in the seal protection cup 47, and the end face is made to contact a shield 37. Then, predetermined precompression is given to the balls 30 and 31 in the second assembly 22 of the balls 17 and 18 in the first assembly 21 of the first double row ball bearing 10, and the second double row ball bearing 25 by screwing a nut 49 on the thread part 48 of a shank 9.
[0039] By the way, generally, in each double row ball bearings 10 and 25, since the major-diameter side ball group 15 and the minor diameter side ball group 28 are arranged at the pinion side, respectively, compared with the minor diameter side ball group 16 and the major-diameter side ball group 29, a big load commits them.
[0040] Here, the relation between the radial internal clearance in each ball groups 15, 16, 28, and 29 at the time of expressing the major-diameter side ball group 15 and the minor diameter side ball group 16 as HL and HS, respectively, and expressing the minor diameter side ball group 28 and the major-diameter side ball group 29 as TS and TL, respectively and a system life is shown below (Table 1).
[0041]
[Table 1]

予圧付与する玉群	予圧付与しない玉群	ラジアル隙間（μm） α1，α2，β1，β2		
		0	10	20
		システム寿命（km）		
HL TL	HS TS	26254	23248	20716
HS TS	HL TL	31915	29411	26531
HS TL	HL TS	33155	30921	28228
	HL HS TS TL	31214	31214	31214

[0042] Drawing 6 is a graphical representation at the time of making an axis of abscissa into radial internal clearances alpha1, alpha2, beta1, and beta2 (micrometer), and making an axis of ordinate into a system life (km). In this drawing, a continuous line a shows the case (precompression is not given to HS and TS) where precompression is given to HL and TL. A broken line b shows the case (precompression is not given to HL and TL) where precompression is given to HS and TS, a two-dot chain line c shows the case (precompression is not given to HL and TS) where precompression is given to HS and TL, and the alternate long and short dash line d shows the case where precompression is given to neither HL nor HS nor TS nor TL.
[0043] And when based on the case where precompression is given to neither HL nor HS nor TS nor TL, from the

above (Table 1) and drawing 6 , it turned out that it is the case where the thing with the longest system life gives precompression to HS and TL, and precompression is not given to HL and TS.
[0044] HL and TS are the major-diameter side ball group 15 located in a pinion side in each double row ball bearings 10 and 25, respectively, and the minor diameter side ball group 28 as mentioned above, and HS and TL are the minor diameter side ball group 16 located in an anti-pinion side in each double row ball bearings 10 and 25, respectively, and the major-diameter side ball group 29. For this reason, when the double row ball bearings 10 and 25 are made to apply to differential equipment 1, HL and TS of loading condition are severer compared with HS and TL. Then, when the load of the load is carried out to each double row ball bearings 10 and 25 by making the radial internal clearances alpha1 and alpha2 of the major-diameter side ball group 15 and the minor diameter side ball group 28 larger than the radial internal clearances beta1 and beta2 of the minor diameter side ball group 16 and the major-diameter side ball group 29, the load is first paid by the minor diameter side ball group 16 and the major-diameter side ball group 29. When a still bigger load works, the radial internal clearances alpha1 and alpha2 in the major-diameter side ball group 15 and the minor diameter side ball group 28 are packed, and carry out a load burden, and the burden of a load can distribute to the major-diameter side ball group 15, the minor diameter side ball group 28, the minor diameter side ball group 16, and the major-diameter side ball group 29. Thereby, the life of the system life of each double row ball bearings 10 and 25 especially the major-diameter side ball group 15, and the minor diameter side ball group 28 can be prolonged.
[0045] In addition, when the value of radial internal clearances alpha1 and alpha2 is set to 20 micrometers from the above (Table 1) and drawing 6 , it also turns out that a system life falls. For this reason, radial internal clearances alpha1 and alpha2 are set up so that it may stop within 10 micrometers.
[0046] Furthermore with this operation gestalt, the first double row ball bearing 10 with small frictional resistance is used as a ball bearing by the side of the pinion gear 6 which a big load commits compared with the anti-pinion 6 side. Thereby, compared with the tapered roller bearing used conventionally, running torque can become small and can raise the effectiveness of differential equipment 1. And by having used not the ball bearing of a single row but the ball bearing of a double row, load-carrying capacity can be enlarged compared with the ball bearing of a single row, and sufficient support rigidity is acquired.
[0047] In addition, by having used the first double row ball bearing 10 of the tandem die which enlarged the pitch diameter D1 of the minor diameter side ball group 15 by the side of a pinion gear 6 as first double row ball bearing 10 compared with the pitch diameter D2 of the major-diameter side ball group 16 If the balls 17 and 18 of both trains are the diameters of said, the number of the balls 17 in the minor diameter side ball group 16 by the side of the pinion gear 6 which a bigger load commits can be made to increase, and, for this reason, a big load can be borne.
[0048] Although the above-mentioned operation gestalt showed the example which used the first double row ball bearing 10 and the second double row ball bearing 25 for the bearing for pinion shaft support of the differential equipment 1 of a car, it is not limited to this. That is, if it is equipment of a configuration of that attach other component parts of a double row ball bearing to another side of a shaft or housing by attaching the bearing washer, and while it is the component part of a double row ball bearing inserts in a shaft to housing, it is applicable to either a shaft or housing.
[0049] Moreover, although the double row ball bearing which has the ball group of two trains, respectively was made to apply to the differential equipment 1 of a car with the above-mentioned operation gestalt, this invention is not limited to this. That is, you may be a configuration with a group as double row anti-friction bearing at a triplex row or the ball group beyond it thru/or the time. The same operation effectiveness as the above-mentioned operation gestalt can be done so by setting up small the radial internal clearance between the rolling element arranged also in this case at a small load side, and its orbital plane compared with the radial internal clearance between the rolling element arranged among the rolling elements of a double row at a large load side, and its orbital plane.
[0050]
[Effect of the Invention] According to this invention a passage clear from the above explanation, the die length of the life of a double row ball bearing can be equalized, and the life of the whole double row anti-friction bearing can be prolonged.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Field of the Invention] This invention relates to double row anti-friction bearing used for the differential equipment carried in a car.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] Drawing 7 shows the cross-section structure of conventional differential equipment 100. This differential equipment 100 has the pinion shaft (drive pinion) 102 in that differential casing 101, and this pinion shaft 102 has the pinion gear 106 which gears to the ring wheel 108 of the differential change gear style 107 at that 1 side. This pinion shaft 102 is supported by the tapered roller bearing 103,104 of the pair single row estranged and arranged in the direction of an axial center free [rotation] again at the circumference of an axial center. The flange yoke 105 connected with a non-illustrated driveshaft is formed in the edge of the pinion shaft 102.
[0003] With the above-mentioned differential equipment 100, the bearing supported for the pinion shaft 102, enabling free rotation consists of a tapered roller bearing 103,104. Especially, big frictional resistance works to the tapered roller bearing 103 by the side of the big pinion gear 106 of thrust loading. For this reason, running torque becomes large and it is possible that the effectiveness of differential equipment 100 falls.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention a passage clear from the above explanation, the die length of the life of a double row ball bearing can be equalized, and the life of the whole double row anti-friction bearing can be prolonged.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Then, it is possible to replace the bearing by the side of a pinion gear 106 with a tapered roller bearing 103, and to use the double row ball bearing of a tandem die. Thus, when replacing with a tapered roller bearing 103 and using the double row ball bearing of a tandem die, the direction of the load to the ball by the side of a pinion gear 106 becomes larger than the load to the ball by the side of the anti-pinion gear 106.
[0005] For this reason, if the radial internal clearance of the ball of each train and an orbital plane is equally set up when a double row ball bearing is used for the above-mentioned differential equipment 100, the lives of the ball of both trains differ greatly and it is possible that a life becomes short as the whole double row ball bearing.

[Translation done.]

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MEANS

[Means for Solving the Problem] Double row anti-friction bearing of this invention with the inner-ring-of-spiral-wound-gasket member which has the orbital plane of a double row Among these, the outer-ring-of-spiral-wound-gasket member which has the orbital plane of a double row which is arranged at wheel part material and this alignment, and corresponds with each orbital plane of said inner-ring-of-spiral-wound-gasket member, The rolling element of the double row infixed, respectively between the orbital planes of each train of said inner-ring-of-spiral-wound-gasket member and an outer-ring-of-spiral-wound-gasket member is included. The radial internal clearance between the rolling element arranged among the rolling elements of these double rows at a small load side and its orbital plane is small set up compared with the radial internal clearance between the rolling element arranged among the rolling elements of said double row at a large load side, and its orbital plane.
[0007] By having set up small the radial internal clearance between the rolling element arranged at a small load side, and its orbital plane like the above-mentioned configuration compared with the radial internal clearance between the rolling element arranged among the rolling elements of a double row at a large load side, and its orbital plane In case a load is paid by the rolling element, a load is mainly supported by the rolling element by which a load is arranged first at a small side. When a still bigger load works, the radial internal clearance in the rolling element by which a load is arranged at a large side is packed, and the assignment of load bearing is made so that a load may be supported by the rolling element here. Thereby, the life of each rolling element is equalized and the system life of the whole double row anti-friction bearing is prolonged.
[0008] Moreover, the inner-ring-of-spiral-wound-gasket member in which double row anti-friction bearing of this invention has the orbital plane of a double row, The outer-ring-of-spiral-wound-gasket member which has the orbital plane of a double row which is arranged at this inner-ring-of-spiral-wound-gasket member and this alignment, and corresponds with each orbital plane of said inner-ring-of-spiral-wound-gasket member, The rolling element of the double row infixed with a pitch diameter different, respectively between the orbital planes of each train of said inner-ring-of-spiral-wound-gasket member and an outer-ring-of-spiral-wound-gasket member is included. The radial internal clearance between the rolling element arranged among the rolling elements of these double rows at a small load side and its orbital plane is small set up compared with the radial internal clearance between the rolling element arranged among the rolling elements of said double row at a large load side, and its orbital plane.
[0009] Also in this case, like the above the radial internal clearance between the rolling element arranged at a small load side, and its orbital plane By having set up small compared with the radial internal clearance between the rolling element arranged among the rolling elements of said double row at a large load side, and its orbital plane In case a load is paid by the rolling element, a load is mainly supported by the rolling element by which a load is arranged first at a small side. When a still bigger load works, the radial internal clearance in the rolling element by which a load is arranged at a large side is packed, and the assignment of load bearing is made so that a load may be supported by the rolling element here. Thereby, the life of each rolling element is equalized and the system life of the whole double row anti-friction bearing is prolonged.
[0010] In addition, the above-mentioned rolling element means a ball or time, as for all of the rolling element of both trains, is good also as a configuration using a ball, and may constitute all of the rolling element of both trains using time. Or a load load uses time as a rolling element of a large side, and you may make it use a ball as a rolling element of a side with a small load load.
[0011]
[Embodiment of the Invention] The case where the double row ball bearing of this invention is made to apply to the bearing for pinion shaft support of the differential equipment attached to a car hereafter is explained to an example based on a drawing.
[0012] A linearity Fig. when the sectional view in which the sectional view in which drawing 1 shows the outline

configuration of differential equipment, and drawing 2 show an important section expanded sectional view, and drawing 3 shows the condition in the middle of attachment of a double row ball bearing, the expanded sectional view to which drawing 4 expresses the radial internal clearance in a double row ball bearing, and drawing 5 equip a pinion shaft with each double row ball bearing, and drawing 6 are the graphical representations at the time of making an axis of abscissa into a radial internal clearance, and making an axis of ordinate into a system life.

[0013] As shown in drawing 1 , said differential equipment 1 has differential casing 2. This differential casing 2 consists of a front case 3 and a rear case 4, and both 3 and 4 are attached by bolt nut 2a. Among the front cases 3, the annular walls 27A and 27B for bearing wearing are formed in the way. This differential casing 2 is carrying out the interior of the pinion shaft (drive pinion) 7 which has a pinion gear 6 to the differential change gear style [which carries out differential linkage of the wheel on either side] 5, and 1 side. The pinion gear 6 has geared to the ring wheel 8 of the differential change gear style 5. The shank 9 of the pinion shaft 7 is formed in the shape of a stage by the side else so that it may become a minor diameter compared with 1 side.

[0014] The shank 9 of the pinion shaft 7 is supported free [the rotation to the circumference of an axial center] by annular wall 27A formed in the front case 3 through the first double row ball bearing 10 in the 1 side. In addition to this, the shank 9 of the pinion shaft 7 is supported by annular wall 27B of the front case 3 free [rotation] through the second double row ball bearing 25 at the circumference of an axial center in the side.

[0015] As shown in drawing 2 , the first double row ball bearing 10 consists of the first single outer-ring-of-spiral-wound-gasket member 11 which has major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a by the side of a pinion, and minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b by the side of an anti-pinion, and the first assembly 21. The first double row ball bearing 10 consists of turning the first assembly 21 to the first outer-ring-of-spiral-wound-gasket member 11 from a pinion side at an anti-pinion side, and attaching from an axial center.

[0016] The first outer-ring-of-spiral-wound-gasket member 11 is attached in the inner skin of the annular wall 27. The counter-bored outer ring is used as this first outer-ring-of-spiral-wound-gasket member 11. Between major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a of this first outer-ring-of-spiral-wound-gasket member 11, and minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b, flat-surface section 11c which follows major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a by the major diameter from minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b is formed. Of this configuration, the inner skin of the first outer-ring-of-spiral-wound-gasket member 11 is formed in the shape of a stage.

[0017] The first single inner-ring-of-spiral-wound-gasket member 13 which has major-diameter inner-ring-of-spiral-wound-gasket orbital plane 13a to which the first assembly 21 counters major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a of the first outer-ring-of-spiral-wound-gasket member 11 in the direction of a path, and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 13b which counters minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b in the direction of a path, It consists of a major-diameter side ball group 15 by the side of a pinion and a minor diameter side ball group 16 by the side of an anti-pinion, and cages 19 and 20 that hold the balls 17 and 18 which constitute each ball groups 15 and 16 to ******, such as a circumferencial direction.

[0018] The shoulder dropping inner ring of spiral wound gasket is used as first inner-ring-of-spiral-wound-gasket member 13. The first inner-ring-of-spiral-wound-gasket member 13 is inserted in the pinion shaft 7. The end face in the first inner-ring-of-spiral-wound-gasket member 13 contacts the end face of a pinion gear 6 from an axial center, and the first inner-ring-of-spiral-wound-gasket member 13 is pinched from the axial center with the end face of a pinion gear 6, and the plastic spacer 23 for a precompression setup by which outer fitting was carried out in the middle of the shank 9 of the pinion shaft 7.

[0019] Between major-diameter inner-ring-of-spiral-wound-gasket orbital plane 13a and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 13b, flat-surface section 13c which follows major-diameter inner-ring-of-spiral-wound-gasket orbital plane 13a by the major diameter from minor diameter inner-ring-of-spiral-wound-gasket orbital plane 13b is formed. Of this configuration, the peripheral face of the first inner-ring-of-spiral-wound-gasket member 13 is formed in the shape of a stage.

[0020] The major-diameter side ball group 15 is arranged through the predetermined radial internal clearance alpha 1 between major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 13a. The minor diameter side ball group 16 is arranged through the predetermined radial internal clearance beta 1 smaller than a radial internal clearance alpha 1 between minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 13b.

[0021] In this first double row ball bearing 10, the path of the ball 17 in the major-diameter side ball group 15 and the path of the ball 18 in the minor diameter side ball group 16 are formed equally, and the pitch diameters

D1 and D2 of each ball groups 15 and 16 differ, respectively. That is, the pitch diameter D1 of the major-diameter side ball group 15 is set up more greatly than the pitch diameter D2 of the minor diameter side ball group 16. Thus, the first double row ball bearing 10 which has the ball groups 15 and 16 from which pitch diameters D1 and D2 differ is called the double row ball bearing of a tandem die.

[0022] The second double row ball bearing 25 consists of the second single outer-ring-of-spiral-wound-gasket member 12 which has minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12a by the side of a pinion, and major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12b by the side of an anti-pinion, and the second assembly 22. The second double row ball bearing 25 consists of turning the second assembly 22 to the second outer-ring-of-spiral-wound-gasket member 12 from an anti-pinion side to a pinion side, and attaching from an axial center. Flat-surface section 12c which follows major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12a by the major diameter from minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12b between major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12a and minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12b is formed in this second outer-ring-of-spiral-wound-gasket member 12. Of this configuration, the inner skin of the second outer-ring-of-spiral-wound-gasket member 12 is formed in the shape of a stage. The second outer-ring-of-spiral-wound-gasket member 12 is attached in the inner skin of annular wall 27B. The counter-bored outer ring is used as this second outer-ring-of-spiral-wound-gasket member 12.

[0023] The second single inner-ring-of-spiral-wound-gasket member 14 which has minor diameter inner-ring-of-spiral-wound-gasket orbital plane 14a to which the second assembly 22 counters minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12a of the second outer-ring-of-spiral-wound-gasket member 12 in the direction of a path, and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 14b which counters major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12b in the direction of a path, It consists of a minor diameter side ball group 28 by the side of a pinion and a major-diameter side ball group 29 by the side of an anti-pinion, and cages 32 and 33 that hold the balls 30 and 31 which constitute each ball groups 28 and 29 to ******, such as a circumferencial direction. The shoulder dropping inner ring of spiral wound gasket is used as second inner-ring-of-spiral-wound-gasket member 14. The second inner-ring-of-spiral-wound-gasket member 14 is inserted in the pinion shaft 7, and the second inner-ring-of-spiral-wound-gasket member 14 is pinched from the axial center with the plastic spacer 23 and shield 37 for a precompression setup.

[0024] Between minor diameter inner-ring-of-spiral-wound-gasket orbital plane 14a and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 14b, flat-surface section 14c which follows minor diameter inner-ring-of-spiral-wound-gasket orbital plane 14a in a minor diameter from major-diameter inner-ring-of-spiral-wound-gasket orbital plane 14b is formed. Of this configuration, the peripheral face of the first inner-ring-of-spiral-wound-gasket member 14 is formed in the shape of a stage.

[0025] The minor diameter side ball group 28 is arranged through the predetermined radial internal clearance alpha 2 between minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12a and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 14a. The major-diameter side ball group 29 is arranged through the predetermined radial internal clearance beta 2 smaller than the predetermined radial internal clearance alpha 2 between major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12b and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 14b.

[0026] In this second double row ball bearing 25, the path of the ball 30 in the minor diameter side ball group 28 and the path of the ball 31 in the major-diameter side ball group 29 are formed equally, and the pitch diameters D3 and D4 of each ball groups 28 and 29 differ, respectively. That is, the pitch diameter D3 of the major-diameter side ball group 28 is set up smaller than the pitch diameter D4 of the minor diameter side ball group 29. This second double row ball bearing 25 is also a double row ball bearing of a tandem die.

[0027] The oil circuit 40 is formed between annular wall 27A by the side of the outer wall of the front case 3, and 1, opening of the oil inlet port 41 of this oil circuit 40 is carried out to the ring wheel 8 side of the oil circuit 40, and opening of the oil outlet 42 of the oil circuit 40 is carried out between annular wall 27A and 27B.

[0028] Differential equipment 1 has a flange yoke 43. This flange yoke 43 has a drum section 44 and the flange 45 formed in this drum section 44 in one. A drum section 44 is attached outside the side other than the shank 9 of the pinion shaft 7 (i.e., a non-illustrated drive shaft). Said shield 37 is infixed between the 1 side-edge side of a drum section 44, and the second inner-ring-of-spiral-wound-gasket member 14 end face of the second double row ball bearing 25. Oil seal 46 is arranged between the peripheral face of a drum section 44, and side opening inner skin besides the front case 3. Oil seal 46 is attached in the seal protection cup 47 of a wrap sake by side opening besides the front case 3. The thread part 48 was formed in the side heel besides a shank 9, and this thread part 48 is projected to the central crevice 41 of a flange 45. The nut 49 is screwed on the thread part 48.

[0029] Thus, the first inner-ring-of-spiral-wound-gasket member 13 of the first double row ball bearing 10 and

the second inner-ring-of-spiral-wound-gasket member 14 of the second double row ball bearing 25 are put in the direction of an axial center by a nut 49 being screwed on a thread part 48 by the end face of a pinion gear 6, and the end face of a flange yoke 43. It will be in the condition that predetermined precompression was given to the balls 17 and 18 of the first double row ball bearing 10, and the balls 30 and 31 of the second double row ball bearing 25, through a shield 37 and the plastic spacer 23.

[0030] In the differential equipment 1 of the above-mentioned configuration, the oil 50 for lubrication is stored on level L in the shutdown condition in differential casing 2. Oil 50 is drawn so that it may have bounded with rotation of a ring wheel 8 at the time of operation and the upper part of the first double row ball bearing 10 and the second double row ball bearing 25 may be supplied through the oil circuit 40 within the front case 3, and it circulates through the inside of differential casing 2 so that the lubrication of the first double row ball bearing 10 and the second double row ball bearing 25 may be carried out.

[0031] Next, the assembly approach of such differential equipment 1 is explained. On the occasion of ******, the first double row ball bearing 10 is beforehand assembled for differential equipment 1, and the radial internal clearance alpha 1 between the major-diameter side ball group 15, and major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 13a is adjusted. Moreover, the radial internal clearance beta 1 between the minor diameter side ball group 15, and minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 13b is adjusted. That is, radial internal clearances alpha1 and beta1 are managed so that a radial internal clearance beta 1 may become small compared with a radial internal clearance alpha 1.

[0032] Moreover, on the occasion of ******, the second double row ball bearing 25 is beforehand assembled for differential equipment 1, and the radial internal clearance alpha 2 between the minor diameter side ball group 28, and minor diameter outer-ring-of-spiral-wound-gasket orbital plane 12a and minor diameter inner-ring-of-spiral-wound-gasket orbital plane 14a is adjusted. Moreover, the radial internal clearance beta 2 between the major-diameter side ball group 29, and major-diameter outer-ring-of-spiral-wound-gasket orbital plane 12b and major-diameter inner-ring-of-spiral-wound-gasket orbital plane 14b is adjusted. That is, radial internal clearances alpha2 and beta2 are managed so that a radial internal clearance beta 2 may become small compared with a radial internal clearance alpha 2.

[0033] And the first outer-ring-of-spiral-wound-gasket member 11 in the first double row ball bearing 10 and the second outer-ring-of-spiral-wound-gasket member 12 in the second double row ball bearing 25 are pressed fit in the annular walls 27A and 27B, respectively.

[0034] Apart from this, the first inner-ring-of-spiral-wound-gasket member 13 is inserted in the pinion shaft 7 for the first assembly 21 of the first double row ball bearing 10, and the first assembly 21 is located in the pinion gear 6 side of the shank 9 of the pinion shaft 7. Next, the first outer-ring-of-spiral-wound-gasket member 11 in the first double row ball bearing 10 is included in the front case 3 in the condition of having made the front case 3 and the rear case 4 still separating. At this time, the first outer-ring-of-spiral-wound-gasket member 11 is pressed fit to the direction of axial center predetermined location equivalent to the step currently formed in the annular wall 27 from 1 side opening of the front case 3. Moreover, the second outer-ring-of-spiral-wound-gasket member 12 of the second double row ball bearing 25 is pressed fit to the direction of axial center predetermined location which hits the step currently formed in the annular wall 28 from side opening besides the front case 3.

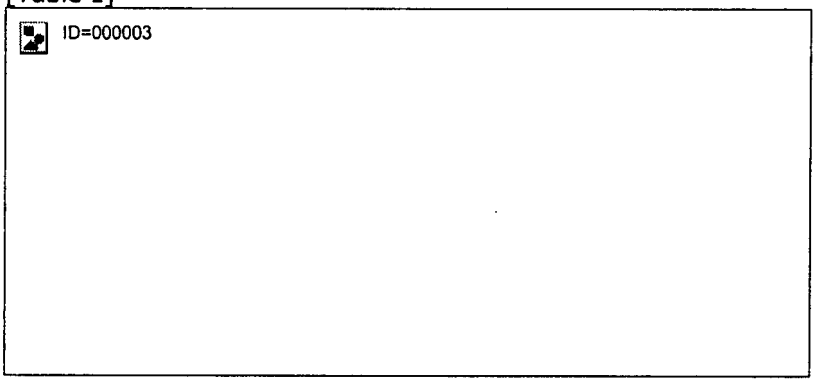
[0035] Apart from this, the first inner-ring-of-spiral-wound-gasket member 13 is inserted in the shank 9 of the pinion shaft 7, and the first assembly 21 is attached.

[0036] The pinion shaft 7 which attached the first assembly 21 as mentioned above from the minor diameter side Moreover, from 1 side opening of the front case 3, it inserts so that the ball 18 of the minor diameter side ball group 16 of the first assembly 21 may fit into minor diameter outer-ring-of-spiral-wound-gasket orbital plane 11b of the first outer-ring-of-spiral-wound-gasket member 11, and so that the ball 17 of the major-diameter side ball group 15 of the first assembly 21 may fit into major-diameter outer-ring-of-spiral-wound-gasket orbital plane 11a of the first outer-ring-of-spiral-wound-gasket member 11.

[0037] Next, outer fitting insertion of the plastic spacer 23 is carried out from side opening besides the front case 3 at the shank 9 of the pinion shaft 7. Then, insertion wearing of the second inner-ring-of-spiral-wound-gasket member 14 is carried out for the second assembly 22 in the second double row ball bearing 25 from side opening besides the front case 3 at the shank 9 of the pinion shaft 7.

[0038] Then, a shield 37 is inserted in the shank 9 of the pinion shaft 7 from side opening besides the front case 3, it equips with oil seal 46, the seal protection cup 47 is attached in side opening besides the front case 3, the drum section 44 of a flange yoke 43 is inserted in the seal protection cup 47, and the end face is made to contact a shield 37. Then, predetermined precompression is given to the balls 30 and 31 in the second assembly 22 of the balls 17 and 18 in the first assembly 21 of the first double row ball bearing 10, and the second double row

ball bearing 25 by screwing a nut 49 on the thread part 48 of a shank 9.
[0039] By the way, generally, in each double row ball bearings 10 and 25, since the major-diameter side ball group 15 and the minor diameter side ball group 28 are arranged at the pinion side, respectively, compared with the minor diameter side ball group 16 and the major-diameter side ball group 29, a big load commits them.
[0040] Here, the relation between the radial internal clearance in each ball groups 15, 16, 28, and 29 at the time of expressing the major-diameter side ball group 15 and the minor diameter side ball group 16 as HL and HS, respectively, and expressing the minor diameter side ball group 28 and the major-diameter side ball group 29 as TS and TL, respectively and a system life is shown below (Table 1).
[0041]
[Table 1]



[0042] Drawing 6 is a graphical representation at the time of making an axis of abscissa into radial internal clearances alpha1, alpha2, beta1, and beta2 (micrometer), and making an axis of ordinate into a system life (km). In this drawing, a continuous line a shows the case (precompression is not given to HS and TS) where precompression is given to HL and TL. A broken line b shows the case (precompression is not given to HL and TL) where precompression is given to HS and TS, a two-dot chain line c shows the case (precompression is not given to HL and TS) where precompression is given to HS and TL, and the alternate long and short dash line d shows the case where precompression is given to neither HL nor HS nor TS nor TL.
[0043] And when based on the case where precompression is given to neither HL nor HS nor TS nor TL, from the above (Table 1) and drawing 6 , it turned out that it is the case where the thing with the longest system life gives precompression to HS and TL, and precompression is not given to HL and TS.
[0044] HL and TS are the major-diameter side ball group 15 located in a pinion side in each double row ball bearings 10 and 25, respectively, and the minor diameter side ball group 28 as mentioned above, and HS and TL are the minor diameter side ball group 16 located in an anti-pinion side in each double row ball bearings 10 and 25, respectively, and the major-diameter side ball group 29. For this reason, when the double row ball bearings 10 and 25 are made to apply to differential equipment 1, HL and TS of loading condition are severer compared with HS and TL. Then, when the load of the load is carried out to each double row ball bearings 10 and 25 by making the radial internal clearances alpha1 and alpha2 of the major-diameter side ball group 15 and the minor diameter side ball group 28 larger than the radial internal clearances beta1 and beta2 of the minor diameter side ball group 16 and the major-diameter side ball group 29, the load is first paid by the minor diameter side ball group 16 and the major-diameter side ball group 29. When a still bigger load works, the radial internal clearances alpha1 and alpha2 in the major-diameter side ball group 15 and the minor diameter side ball group 28 are packed, and carry out a load burden, and the burden of a load can distribute to the major-diameter side ball group 15, the minor diameter side ball group 28, the minor diameter side ball group 16, and the major-diameter side ball group 29. Thereby, the life of the system life of each double row ball bearings 10 and 25 especially the major-diameter side ball group 15, and the minor diameter side ball group 28 can be prolonged.
[0045] In addition, when the value of radial internal clearances alpha1 and alpha2 is set to 20 micrometers from the above (Table 1) and drawing 6 , it also turns out that a system life falls. For this reason, radial internal clearances alpha1 and alpha2 are set up so that it may stop within 10 micrometers.
[0046] Furthermore with this operation gestalt, the first double row ball bearing 10 with small frictional resistance is used as a ball bearing by the side of the pinion gear 6 which a big load commits compared with the anti-pinion 6 side. Thereby, compared with the tapered roller bearing used conventionally, running torque can become small and can raise the effectiveness of differential equipment 1. And by having used not the ball bearing of a single row but the ball bearing of a double row, load-carrying capacity can be enlarged compared with the ball bearing of a single row, and sufficient support rigidity is acquired.

[0047] In addition, by having used the first double row ball bearing 10 of the tandem die which enlarged the pitch diameter D1 of the minor diameter side ball group 15 by the side of a pinion gear 6 as first double row ball bearing 10 compared with the pitch diameter D2 of the major-diameter side ball group 16 If the balls 17 and 18 of both trains are the diameters of said, the number of the balls 17 in the minor diameter side ball group 16 by the side of the pinion gear 6 which a bigger load commits can be made to increase, and, for this reason, a big load can be borne.

[0048] Although the above-mentioned operation gestalt showed the example which used the first double row ball bearing 10 and the second double row ball bearing 25 for the bearing for pinion shaft support of the differential equipment 1 of a car, it is not limited to this. That is, if it is equipment of a configuration of that attach other component parts of a double row ball bearing to another side of a shaft or housing by attaching the bearing washer, and while it is the component part of a double row ball bearing inserts in a shaft to housing, it is applicable to either a shaft or housing.

[0049] Moreover, although the double row ball bearing which has the ball group of two trains, respectively was made to apply to the differential equipment 1 of a car with the above-mentioned operation gestalt, this invention is not limited to this. That is, you may be a configuration with a group as double row anti-friction bearing at a triplex row or the ball group beyond it thru/or the time. The same operation effectiveness as the above-mentioned operation gestalt can be done so by setting up small the radial internal clearance between the rolling element arranged also in this case at a small load side, and its orbital plane compared with the radial internal clearance between the rolling element arranged among the rolling elements of a double row at a large load side, and its orbital plane.

[0050]

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the whole differential equipment configuration which shows the first operation gestalt of this invention.
[Drawing 2] Similarly it is an important section expanded sectional view.
[Drawing 3] It is the sectional view showing the condition in the middle of attachment of a double row ball bearing similarly.
[Drawing 4] It is the expanded sectional view which similarly expresses the radial internal clearance in a double row ball bearing.
[Drawing 5] It is a linearity Fig. at the time of similarly equipping a pinion shaft with each double row ball bearing.
[Drawing 6] It is a graphical representation at the time of making an axis of abscissa into a radial internal clearance, and making an axis of ordinate into a system life.
[Drawing 7] It is the sectional view showing the whole differential equipment configuration which shows the conventional example.
[Description of Notations]
1 Differential Equipment
6 Pinion Gear
7 Pinion Shaft
10 First Double Row Ball Bearing
11 First Outer-Ring-of-Spiral-Wound-Gasket Member
12 Second Outer-Ring-of-Spiral-Wound-Gasket Member
13 First Inner-Ring-of-Spiral-Wound-Gasket Member
14 Second Inner-Ring-of-Spiral-Wound-Gasket Member
15 Major-Diameter Side Ball Group
16 Minor Diameter Side Ball Group
17 18 Ball
21 First Assembly
22 Second Assembly
25 Second Double Row Ball Bearing
alpha1, alpha2 Radial internal clearance
beta1, beta2 Radial internal clearance
D1, D2 Pitch diameter
28 Minor Diameter Side Ball Group
29 Major-Diameter Side Ball Group
30 31 Ball

[Translation done.]

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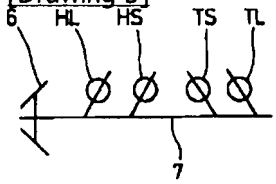
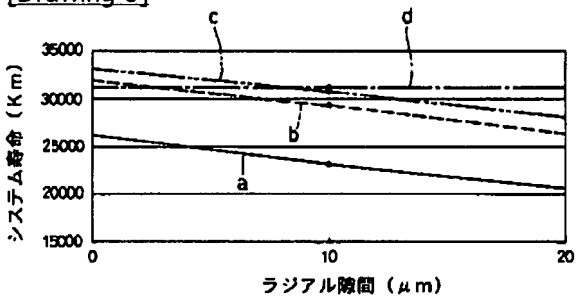
DRAWINGS

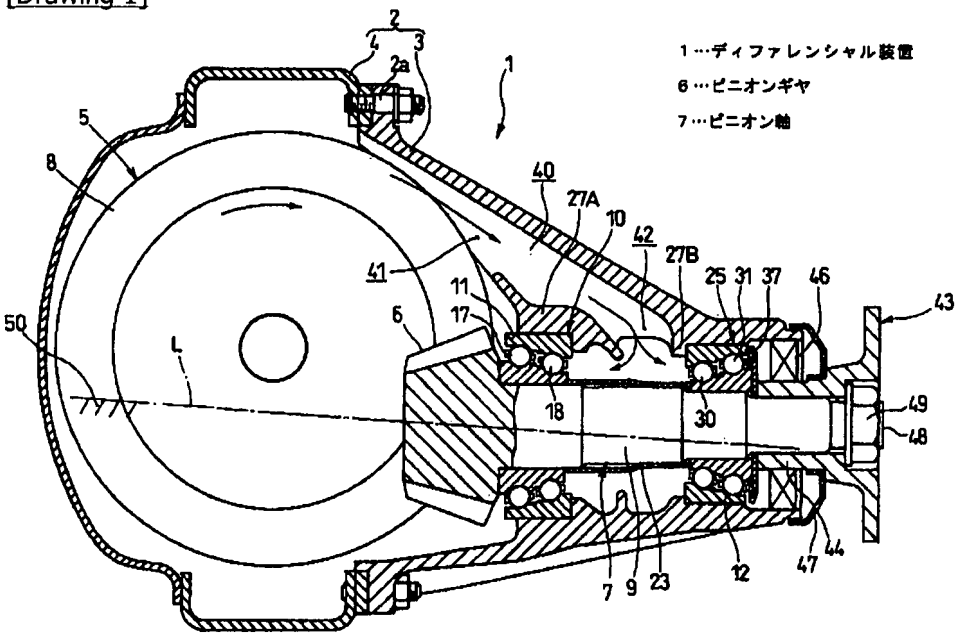
[Drawing 5]



[Drawing 6]

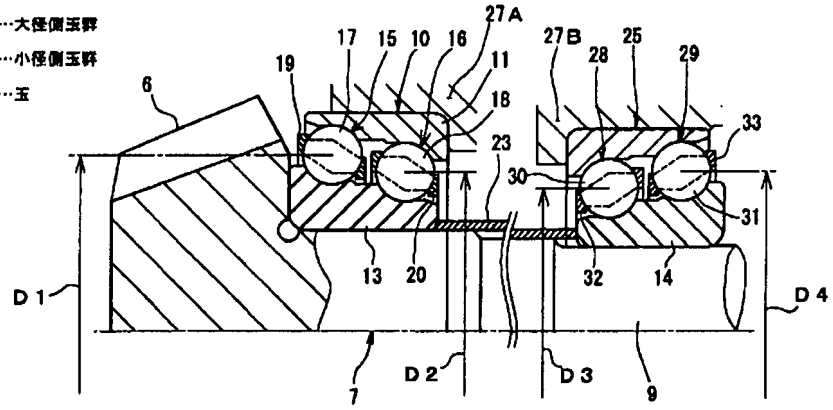


[Drawing 1]

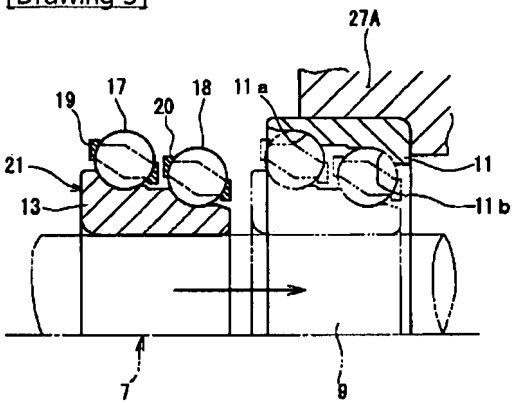


[Drawing 2]

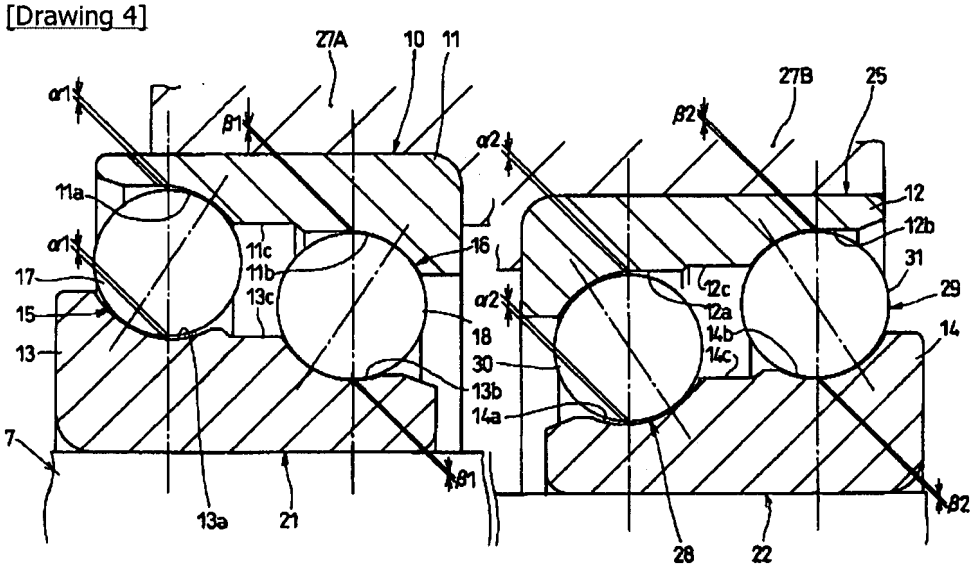
１０…第一の複列玉軸受
１１…第一の外輪部材
１２…第二の外輪部材
１３…第一の内輪部材
１４…第二の内輪部材
１５…大径側玉群
１６…小径側玉群
１７，１８…玉



[Drawing 3]

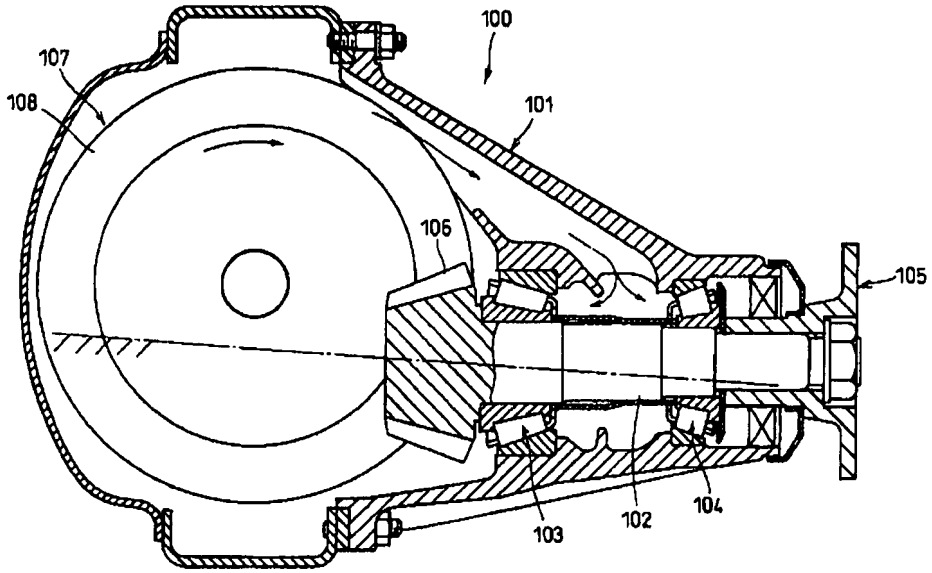


[Drawing 4]



α１，α２…ラジアル隙間　　２８…小径側玉群
β１，β２…ラジアル隙間　　２９…大径側玉群
Ｄ１，Ｄ２…ピッチ円直径　　３０，３１…玉

[Drawing 7]



[Translation done.]